FINAL REPORT

February 9, 2010

Subgroup 3
How do technologies get eliminated based on cost, energy, environmental factors?

Questions Addressed by the Subgroup:

1. How should a negative impact of a GHG control option or GHG emissions from a control device be considered (e.g., an overall decrease in process efficiency or increase in criteria air pollutants from fossil-fuel fired control device)?

2. Aside from potential collateral air pollutant increases which are associated directly with the source what other, if any, environmental impacts should be considered, and how would they be evaluated, in the BACT GHG environmental analysis?

3. Whether (and if so, how) energy-related impacts that do not occur on site and are not part of the source (e.g., raw material or fuel production, off site electric demand/utilization) can be considered and evaluated in the energy impacts analysis?

4. How should the differences in magnitude/potency of GHGs emissions as compared with criteria pollutants be taken into account in assessing cost impacts and the appropriate dollar per ton level of acceptable costs for BACT? What source specific factors may be suitable for consideration when evaluating the relative cost per ton and incremental cost per ton for GHGs emission reductions? Can industry-wide benchmarks or performance be considered and if so, how?

5. Evaluation of the carbon neutrality of biogenic CO_2 emissions under PSD and BACT.

Discussion and Recommendations

(1) Question - How should a negative impact of a GHG control option or GHG emissions from a control device be considered (e.g., an overall decrease in process efficiency or increase in criteria air pollutants from fossil-fuel fired control device)?

Current EPA policy/guidance - As a part of PSD review, permitting authorities have a long standing practice of considering effects of multiple pollutants and the application of BACT. For example, the control of nitrogen oxides (NOx) emissions may result in increased carbon monoxide (CO) in combustion applications. States have sometimes prioritized the reduction of NOx above that of CO control strategies, approving low NOx control strategies and good combustion practices as BACT.

Consensus - EPA should allow permitting authorities to continue their current practices of reviewing BACT within the context of the entire application. In other words, the assessment of BACT should not be done without consideration of environmental impacts on other air pollutants. In no case should a control strategy for one pollutant result in, or contribute to, the exceedance of a NAAQS for another pollutant.

In the case of a control strategy that results in the increase in other pollutants, e.g., the parasitic load increase associated with certain GHG strategies, the permit authority can consider the effects of increases in other pollutants that would be incurred with the use of that control strategy. The permitting authority has the obligation to determine and document the air pollution priorities associated with the permit review with the goal of optimizing emission reduction benefits.

Non-consensus - The workgroup did not arrive at a consensus regarding the case where a permitting authority would eliminate a control strategy as BACT for a criteria pollutant if it increased GHG emissions significantly.

(2) Question: Aside from potential collateral air pollutant increases which are associated directly with the source, what other, if any, environmental impacts should be considered, and how would they be evaluated, in the BACT GHG environmental analysis.

Current Policy/guidance - EPA has long recognized the obligation for a permitting authority to meaningfully consider collateral environmental impacts and to ultimately adopt a more protective BACT emission limitation to ameliorate adverse environmental effects. Consistent with this authority, the EAB has made it clear that EPA has an affirmative duty under the "environmental impact" prong of the BACT analysis, where competing BACT technologies would have different collateral environmental impacts, to specifically evaluate those impacts and consider the relative benefits and disbenefits of competing options. The EAB has also addressed EPA's obligations to consider the impacts on soil, vegetation, species and habitat, and how those obligations relate to the permitting authority's obligation to consider collateral impacts.

While environmental considerations may involve a range of impacts, water impacts must be among those carefully considered. Existing policy has long recognized the imperative to evaluate the water and waste-related impacts. Consideration of production processes or practices that are inherently less polluting may be more environmentally effective in alleviating waste and water impacts.

Recommendation 1 – Considering Beneficial or Adverse Water-Related Impacts: While environmental considerations may involve a range of impacts, water impacts must be among those carefully considered. Fresh water resources are scarce and, in some arid regions, provide a precarious economic lifeline and are vital for biodiversity. Further, contamination of water supplies can have a cascade of adverse environmental impacts and entail costly clean up measures. The beneficial or adverse water-related impacts must be among the central environmental considerations in determining BACT, including the evaluation of inherently lower polluting processes and practices.

Recommendation 2 – Consideration of Threatened or Endangered Species, Hazardous and Solid Waste Impacts, and Soils and Vegetation: The evaluation of environmental impacts in determining BACT, including the assessment of inherently lower polluting processes and practices, must include consideration of threatened or endangered species as well as hazardous and solid waste effects and the impacts on soils and vegetation.

Consensus - EPA should encourage permitting authorities to continue their current practices of reviewing BACT within the context of the entire application, and also emphasize assessments should not be done without careful consideration of environmental impacts (e.g., overall water quality as well as water quantity especially in regionally sensitive areas). Additionally, in evaluating a control technology alternative environmental justice should be a relevant consideration in the environment effects analysis. Regulation of GHGs under PSD should be done in a balanced manner that gives full consideration to collateral environmental impacts.

(3) Question - Whether (and if so, how) energy-related impacts that do not occur on site and are not part of the source (e.g., raw material or fuel production, off site electric demand/utilization) can be considered and evaluated in the energy impacts analysis?

Current Policy - In determining BACT, the statute mandates that permitting authorities must determine, on a case-by-case basis, the "best available control technology" "taking into account energy, environmental, and economic impacts and other costs. The draft workshop manual generally encourages consideration of energy benefits and penalties associated with the source and has recognized that the permit authority has latitude to consider indirect energy-related impacts especially where they are significant.

Consensus - Subgroup 3 agrees energy efficiency measures are important and should be further considered by the full working group. "Where" the energy efficiency considerations take place (onsite versus offsite) and "how" (e.g. in the Steps of the BACT process or outside of BACT) are important questions that should be explored further by the Workgroup and EPA. Therefore, we conclude these issues should be taken up in phase two of the process and may best be addressed in a "white paper." Finally, Subgroup III recommends that, as a general policy matter, EPA should take up the question as to what other mechanisms may be available to promote and encourage energy efficiency outside of the BACT process.

Non consensus Issues - The following alternatives reflect the various positions of subgroup members and are not intended to be presented in any order of preference.

(1) EPA Should Examine Appropriate Opportunities to Provide Incentives for Energy Efficiency - Well designed energy efficiency measures can secure multipollutant reductions and achieve other collateral environmental benefits, strengthen energy security, and save costs. Energy efficiency must be addressed in a manner consistent with the BACT framework and provides regulatory certainty. EPA, in collaboration with state permit agencies and other interested stakeholders, should design policies to encourage energy efficiency.

(2) Permittees should examine appropriate opportunities to increase energy efficiency - Well designed energy efficiency actions can led to multi-pollutant reductions and achieve other collateral environmental benefits, strengthen energy security, and save costs. For example, use of over-fired air or regular tune-ups of boilers can reduce fuel use and GHG emissions. Frequently, permittees have incentives to undertake energy efficiency projects to reduce costs

but due to limited capital, poor return on investment and the opportunity costs of some energy efficiency projects are not worth pursuing. Finally, the BACT process itself (its delays and cost to undertake the necessary analyses) can discourage beneficial projects from being undertaken so streamlining BACT steps for energy efficiency projects such as expanded CHP can help reduce emissions.

(4) Question - How should the differences in magnitude/potency of GHGs emissions as compared with criteria pollutants be taken into account in assessing cost impacts and the appropriate dollar per ton level of acceptable costs for BACT? What source specific factors may be suitable for consideration when evaluating the relative cost per ton and incremental cost per ton for GHGs emission reductions? Can industry-wide benchmarks or performance be considered and if so, how?

Current Policy/guidance - The Clean Air Act specifies that BACT is an "emission limitation based on the maximum degree of reduction of each pollutant ..., on a case-by-case basis, taking into account energy, environmental, and *economic impacts and other costs* ...." CAA § 169(3) (emphasis added). EPA's regulations incorporate this language verbatim. *See, e.g.,* 40 C.F.R. § 52.21(b)(12). The statute and regulations provide no further explanation as to how "economic impacts and other costs" factor into a BACT determination.

EPA's 1990 Draft PSD Workshop Manual explains a method of accounting for cost that typically is used: "Average and incremental cost effectiveness are the two economic criteria that are considered in the BACT analysis." PSD Workshop Manual at B-31. Average cost effectiveness is calculated by dividing the total annualized cost of the BACT alternative by the tons per year of emissions of the regulated pollutant that would be reduced by applying the given BACT alternative. *Id.* at B-37. Incremental cost effectiveness is determined by dividing the difference in annual costs of two BACT alternatives by the difference in the annual emissions rates achieved by the two alternatives. *Id.* at B-41.

According to EPA, "if the cost of reducing emissions with the top control alternative, expressed in dollars per ton, is on the same order as the cost previously borne by other sources of the same type in applying that control alternative, the alternative should initially be considered economically achievable, and therefore acceptable as BACT." *Id.* at B-44. But, EPA acknowledges that site-specific considerations may cause a cost that is acceptable to a prior project to not be cost effective for a subsequent project. *Id.*

EPA has not established through regulation or policy any fixed values for judging cost effectiveness in BACT determinations. Individual regulatory agencies evaluate the cost-effectiveness of control options based on project-specific factors. Because project-specific factors inform the evaluation, individual regulatory agencies have found a range of cost-effectiveness thresholds to be acceptable for existing regulated pollutants.

Recommendation: Each GHG should be assessed on a CO_2e basis in assessing economic impacts and other costs when making BACT determinations. This will assure comparable economic assessments for GHGs with different GWPs.

The BACT economic impact assessment considers the ability of the source to bear the cost of air pollution controls. Because CO2 is emitted in substantially greater quantities than the currently regulated pollutants, cost-effectiveness values will accordingly be significantly smaller on a per unit weight basis.

Consensus: Subgroup 3 is in consensus with these recommendations. Certain Workgroup members further recommend that a cost effectiveness value for GHGs in the range of $3 to $15 per ton CO_2e should be established. Other members recommend that a cost effectiveness value for GHGs in the range of $30 to $150 per ton of CO2e is reasonable, based on the range of published costs for CCS for mature to first-of-a-kind CCS technologies. Other Workgroup members did not support these particular limits or establishing fixed values for GHGs and recommend that EPA provide guidance to permitting authorities on the range of cost effectiveness values based on status of various technologies.

Discussion: Although cost effectiveness is expressed in dollars per ton, it ultimately is a measure of the absolute economic burden a given source should bear in the interest of controlling air pollution. Individual regulatory agencies must consider project-specific factors in evaluating and determining what is an acceptable economic burden on a case-by-case basis. CO_2 is typically emitted at rates far higher than the currently regulated pollutants – the "tailoring rule" proposal signals that CO_2 emissions should generally be expected to be two to three orders of magnitude greater than the currently regulated pollutants, such as NOx and SO2. Thus, if the currently-accepted range of values for cost effectiveness are applied to CO_2, individual regulatory agencies should consider, on a project-specific basis, cost-effectiveness values that are two to three orders of magnitude lower than the values that have historically been viewed as acceptable. Otherwise, the established review process should remain the same.

(5) Question – How to treat biomass from a GHG emissions standpoint for applicability to PSD and BACT determination. .

Current Policy/guidance:

- EPA has never had to address the issue of carbon neutrality for any pollutant under BACT, so there is no precedent in the BACT program.

- Combustion of biomass, as compared to fossil fuels, does not itself reduce carbon dioxide emissions measured at the stack because the carbon dioxide emitted is roughly the same per unit of energy regardless of the fuel type.[1]

- The BACT requirement applies to each pollutant subject to regulation under the CAA "emitted from, or which results from" any new or modified major emitting facility.[2] Available control technologies are those air pollution control technologies or techniques "with a practical potential for application to the *emissions unit*."[3]

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[1] Searchinger T., et al., *Fixing a Critical Climate Accounting Error*, 326 Science 527, 528 (Oct. 23, 2009), and authorities cited therein.

[2] 42 U.S.C. 7475(a)(4).

[3] NSR Guidance Manual at B.5 (emphasis added). [Don't need to restate other subgroup issues in this paper]

Thus, the BACT requirement has focused on controlling emissions at the level of the new facility or emissions unit. Accordingly, the BACT program does not require any lifecycle analyses to be conducted for fuel used in combustion project. By the same token, the BACT applicability determination has not hinged on whether there is an emissions reduction at the fuel production stage.
Similarly, the BACT applicability determination does not involve assessments of offsite land use changes associated with the fuels used in permitting any new facility or modification to an existing combustion unit. Rather, under EPA's policy set out in the NSR Guidance Manual, collateral environmental impacts associated with a certain control technology are to be considered at step 4 of the top-down BACT analysis.

Why this is important:

How "carbon neutrality" of biomass is defined is of central importance in developing effective bioenergy policies to combat climate change. Combustion of biomass can play an important role in addressing climate change and energy security issues. However, it is important to consider the sustainably of forest harvests, changes in land use, and the geographical scale (regional or national) of these changes when assessing biomass combustion policies. Addressing the question of biomass neutrality is also important to provide certainty to the regulated community, investors in renewable energy and state regulators and streamline the permitting process because a growing number of projects aimed at climate mitigation and increasing energy security involve greater use of biomass. For example, between 2000 and 2006 the amount of energy used by the paper industry that is derived from biomass has increased from 56% to over 64% and more biomass energy projects are being started every month. Many other industries are looking to expand use of biofuels given various state or company climate change initiatives as well as state renewable energy standards that reward utilities to increase use of electricity derived from biomass (and other renewables). With increased demand for biomass, there is a concern that demand for biomass material will exceed the productive capacity of forests and croplands and, as a result, forest and agricultural stocks will decline over time.

While it is has been a long-term principle of climate change policy that burning biomass rather than fossil fuels is good from climate change perspective, concerns have recently arisen that increased demand might result in depleted stocks of stored biomass carbon in forests and elsewhere and the upstream emissions associated with biomass fuels (e.g. from fertilizer use), in some situations, can offset much of their potential benefits. The first of these is a concern related to the biomass carbon cycle (i.e. whether the cycle is, and will remain, in balance) while the second is a broader question of the comparative life cycle benefits of different energy sources, both fossil and biomass-derived.

Consensus - Given the broader policy implications concerning the extent to which the combustion of biomass is carbon neutral relative to PSD BACT determinations, and other Administration policies, Subgroup 3 is of the opinion that EPA is in the best position to determine how biomass fuels should be treated in the BACT analysis or whether the use of biomass fuels (or certain biomass fuels) should be sufficient to legally avoid NSR, and therefore the applicability of PSD/BACT. During Subgroup 3 calls and in the full Workgroup, there was a healthy exchange of views around the two alternatives presented below but little narrowing of differences. State representatives indicated a case by case life cycle assessment for each project would be unworkable and too resource intensive.

Non consensus - The following alternatives reflect the various discussions of subgroup members and are not intended to be presented in any order of preference.

(1) This alternative assumes the combustion of biomass is always carbon neutral, and asserts that CO2 emissions from biomass combustion should be excluded from major source and project significant threshold determinations for the purposes of PSD and BACT applicability[4]. In addition, this view assumes that this alternative would exclude those same emissions for any netting projects or calculations.

Rationale: Some in the workgroup believe that the carbon neutrality of biomass should be upheld in the context of BACT. The CO2 removed from the atmosphere during photosynthesis is converted into organic carbon and stored in biomass, such as trees and crops. When harvested and combusted, the carbon in the biomass is released as CO_2, thus completing the carbon cycle. Biomass CO_2 neutrality is independent of any consideration of material sustainability of the sources of biomass – the CO_2 released back to the atmosphere is the same CO_2 that was recently removed or "sequestered" from it – and does not need to be demonstrated with a case by case lifecycle analysis.

As public policy increasingly develops incentives for the use of renewable fuels, concern arises over the potential depletion of forest carbon stocks due to the unsustainable use of the forest resource and potential upset of the carbon balance. When measuring carbon flows, international accounting conventions properly recognize the difference between fossil fuel emissions and carbon flows related to the natural carbon cycle. The Intergovernmental Panel on Climate Change (IPCC) counts the combustion of fossil-based fuel as GHG emissions while accounting for emissions and sequestration related to land use separately. These biomass-related carbon flows only affect atmospheric carbon if there is an imbalance between the rate of uptake of CO_2 by plants and the rate of return of biogenic carbon to the atmosphere (through combustion, decay or respiration) over very large areas and time periods. Thus case by case lifecycle assessments are not relevant to atmospheric concentrations of GHG and therefore not warranted. In addition, case by case reviews of carbon neutrality will create huge uncertainty, cost inequities and an unlevel playing field among facilities and states utilizing biomass fuels. In the United States, re-planted or re-grown harvested forests result in increases in carbon stocks. Using analysis from the U.S. Forest Service, EPA accounts for the carbon stock changes related to land use in its national annual inventory reports to the United Nations Framework Convention on Climate Change (UNFCCC).[5] These national GHG inventories recognize the carbon neutrality of biomass and also account for changes in the amount of carbon stored in forests, landfills and other pools. Given the increasing forest carbon stocks in the U.S., the forest carbon cycle is in balance and achieving net removals of CO2 from the atmosphere.

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[4] If other pollutants trigger the major source or significance thresholds, then the facility would still undertake the PSD/BACT process, as presently required, but only for those affected pollutants.

[5] See Inventory of US Greenhouse Gas Emissions and Sinks (2007.

Life cycle studies related to the production of certain biofuels from biomass (often agricultural) assess the overall environmental or carbon benefits of its use including direct effects of land use changes. However, in these studies the carbon neutrality of the combustion of biomass fuel is not in question. It is the greenhouse gas impacts of the overall life cycle system from land use changes, cultivation, refining, and transport that are assessed.

The current Renewable Fuel Standard, RFS1, was adopted by the EPA to implement the Energy Policy Act of 2005. More recently, reflecting concerns regarding a more accurate value in the GHG reduction benefits of substituting different types of transportation biofuels for fossil fuel, the Energy Independence and Security Act of 2007 (EISA) mandated the assessment of GHG impacts of biofuels via life cycle assessment studies. These studies aggregate GHG emissions, both direct and indirect, for each biofuel and then compare them to the EISA-required thresholds for the different biofuels. Explicit in the EPA assessment is the recognition that CO_2 emissions from the combustion of these transportation biofuels are neutral or zero.

The need for these studies, their conclusions and the establishment of thresholds for different transportation biofuels in no way alters the inherent properties of biomass CO_2 neutrality. This is further confirmed recently by the EPA proposed rule to implement EISA in a new Renewable Fuel Standard, RFS2 (74 Fed. Reg. 24904 (May 26, 2009). In the detailed explanation of the modeling framework for these complex life cycle studies, EPA identifies a sequence of highly complex models that are used for the determination of whether various fuels achieve the required GHG reductions. In determining the treatment of CO_2 emitted from combustion of biomass-based fuels during the processing of feedstock into transportation biofuels, EPA makes clear, in VI.B.5.d Processing, that *"[t]he emissions from combustion of biomass fuel source are not assumed to increase net atmospheric CO_2 levels. The CO_2 emitted from biomass-based fuels combustion does not increase the atmospheric CO_2 concentrations, assuming the biogenic carbon emitted is offset by the uptake of CO_2 resulting from the growth of new biomass. Therefore, the CO_2 emissions from biomass combustion as a process fuel source are not included in the life cycle GHG inventory of the ethanol (and other biofuels) plant.*" 74 Fed. Reg. 25039.

Carbon neutrality of biomass is simply one input into the total life cycle emissions calculation of biomass fuel production. National accounting is the proper scale at which carbon stock depletion or increases from land use change should be assessed in life cycle analyses. In fact, since the U.S. accounts for the carbon reductions when timber is harvested, it would be double counting if CO2 emissions are counted again when the biomass is burned. Finer scales would be difficult to measure and implement and have no relevance to atmospheric concentrations of CO_2. Other life cycle impacts including emissions associated with the procurement, transport, and use of biomass are only relevant if they are more than those associated with the fossil energy displaced (and its associated refinement and transportation emissions) which is unlikely to be the case.

Sustainable forest management, policies to increase biomass supply, and periodic monitoring of carbon stocks on a national scale are the proper policy tools for addressing increased demand for the forest resource due to renewable energy mandates and incentives. In addition, case by case life cycle assessment of fuel usage, as suggested in Alternative 2 below, is not part of the current BACT review process and should not become a requirement for GHGs.

If CO_2 from biomass combustion is not carbon neutral, energy users will prefer fossil fuels as they have higher heating values and are more efficient. It is also important to exclude carbon neutral projects from the whole PSD process and not just the BACT review because of the significant burdens that could be placed on either the facilities including BACT review of other pollutants that by themselves would not trigger appropriate major source thresholds or the states who have limited resources and for no environmental benefit. Undertaking a BACT for a modification involving biomass could discourage a project and its emission reduction benefits because the BACT process can be more costly than the energy savings from the modification. Finally, if a modification involves a mix of biomass and fossil fuels, the project still must go through PSD/BACT if the fossil fuel CO_2 is above the significance thresholds.

(2) This alternative recognizes that not all biomass is equally carbon neutral. While some sustainably harvested or waste biomass might be considered "clean fuel" under the statute's BACT definition, the determination of a particular biomass fuel's "carbon neutrality" must be based on an assessment of the carbon emissions associated with the fuel's full life cycle, in order to avoid creating perverse incentives that actually increase overall carbon emissions. Recognizing that the evaluation of the impact of biomass fuels on atmospheric concentrations of greenhouse gases is a complex process, and that EPA is in the best position to evaluate this issue, an EPA "white paper" should be developed outlining the major factors that should be taken into account in identifying what biomass types are in fact carbon neutral, so that the question whether combustion of biomass at a facility would result in increased atmospheric carbon dioxide concentrations can be evaluated under the PSD process. This analysis should include 1) type of fuel (such as wastes, forest and crop residues, slash and pre-commercial thinning, planted crops, natural forest, and managed plantations), 2) source of the biomass (existing cropland or managed plantations, newly cleared/cultivated cropland or tree plantations, old growth forests, etc.), 3) direct emissions from processing and transportation of the fuel, and 4) indirect emissions of plant and soil carbon resulting from the market-mediated impacts on land conversion globally. States could use the white paper to determine on a case-by-case basis whether combustion of biomass at a given facility would result in a net increase of atmospheric concentrations of carbon dioxide. This document could also identify situations in which the carbon dioxide from biomass combustion can be offset by the carbon absorbed during the growth cycle. Such situations may include combustion of forest residues from existing and actively managed plantations and combustion of certain crop residues from existing agricultural land.

Rationale: Some in the workgroup believe that an approach that does not accurately account for the direct and indirect emissions associated with biomass production and combustion on atmospheric greenhouse gas concentrations could have severe, detrimental impacts on a core objective of US biomass policy, namely, reduction of greenhouse gas emissions. It is worth noting that the BACT process applies to facilities that use a wide variety of biomass feedstocks, not solely forestry products from existing plantations.

Several authorities agree that life cycle accounting, which includes indirect emissions resulting from land use changes, is necessary if the analysis is to bear any relationship to the real world impacts of biomass fuel production and use on carbon dioxide concentrations: The U.S. Congress specifically recognized the potentially significant greenhouse gas emissions associated with indirect land use change resulting from increased demand of biomass in the Energy

Independence and Security Act of 2007 (EISA 2007), which requires a life cycle assessment of greenhouse gas emissions from biofuels, including consideration of emissions from indirect land use change (now codified in the amendments to § 211(o) of the Clean Air Act[6]). In the proposed regulations to implement EISA 2007, EPA refused to ignore emissions, whether direct or indirect, that are related to biofuel production merely because they occur outside of the U.S: "GHG emissions impact global warming wherever they occur, and if the purpose is to achieve some reduction in GHG emissions in order to help address global warming, then ignoring GHG emissions because they are emitted outside our border . . . interferes with the ability to achieve that objective."[7]

UN-Energy of the United Nations recognizes that "[t]he ability of various bioenergy types to reduce greenhouse gas emissions varies widely, and where forests are cleared to make way for new energy crops, *the emissions can be even higher than those from fossil fuels.* Unless new policies are enacted . . ., *the environmental and social damage could in some cases outweigh the benefits.*"[8] Similarly, the Joint Research Centre of the European Commission concluded that "[i]indirect land use change could potentially release enough greenhouse gas to negate the savings from conventional EU biofuels."[9]

In addition, although the IPCC accounts for emissions from land use changes separately, it has warned that, to avoid underreporting of the actual impacts of substitution of biomass for fossil fuels on atmospheric carbon dioxide concentrations, "any changes in biomass stocks on lands . . . resulting from the production of biofuels would need to be included in the accounts."[10]

Finally, leading scientists have recently emphasized that replacing fossil fuels with biofuels does not automatically result in reductions of emissions of carbon dioxide because "the potential of bioenergy to reduce greenhouse gas emissions inherently depends on the source of the biomass and its net land use effects."[11] Therefore, any accounting procedure that does not take into account these factors is improper. [12]

Country-specific accounting for domestic greenhouse gas emissions and sinks in accordance with the UNFCCC (as described in Alternative 1) is an important, but limited, tool. The use of biomass for energy in the U.S. affects global agricultural markets and, as a result, global land use patterns. EPA's analysis in the Proposed RFS-2 contradicts the notion that emissions occurring outside the U.S. are irrelevant and thus undermines the assertion that "[g]iven the increasing

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[6] EPA's proposed RFS-2, which when finalized will implement the requirements of EISA 2007, recognizes that greenhouse gas emissions from indirect land use change can be significant. *See generally* Regulation of Fuels and Fuel Additives: Changes to Renewable Fuel Standard Program; Proposed Rule, 74 Fed. Reg. 24904 (May 26, 2009) (Proposed RFS-2).

[7] Proposed RFS-2, 74 Fed. Reg. at 25024.

[8] UN-Energy, *Sustainable Bioenergy: A Framework for Decisionmakers*, 5 (Apr. 2007) ("Sustainable Bioenergy"), *available at* http://esa.un.org/un-energy/pdf/susdev.Biofuels.FAO.pdf.

[9] R. Edwards *et al.*, *Biofuels in the European Context: Facts and Uncertainties*, 11 (JRC European Commission 2008), *available at* http://ec.europa.eu/dgs/jrc/downloads/jrc_biofuels_report.pdf.

[10] R. Watson *et al.*, *Land Use, Land-Use Change, and Forestry*, § 6.3.2.3 (IPCC, Cambridge Univ. Press, Cambridge, 2000), *available at* http://www.grida.no/publications/other/ipcc_sr/?src=/Climate/ipcc/land_use/index.htm.

[11] Searchinger T., et al., *Fixing a Critical Climate Accounting Error*, 326 Science at 528.

[12] *Id.*

forest carbon stocks in the U.S, the carbon cycle is in balance and achieving net CO_2 removals from the atmosphere" in Alternative 1. In the Proposed RFS-2, EPA explicitly recognizes that increase in domestic demand for biofuels can affect significant changes in land use internationally and that there is no scientific basis for excluding those emissions from the analysis as the location of emissions is irrelevant to climate impacts. [13] Therefore, it is the balance of carbon sinks and carbon emissions at the global level that is relevant to determining a biofuel's carbon neutrality.

It is well-recognized that accounting of greenhouse gas emissions associated with the full life cycle of biomass is evolving. Rather than mandate a particular outcome, this EPA white paper approach would provide states with comprehensive information while allowing for a case-by-case analysis, as required by the statute, and allow states the flexibility to incorporate new scientific evidence into their analyses.

Finally, at the December 3, 2009 meeting of the full BACT Workgroup, several members raised the issue of whether certain types of biomass could be considered a "clean fuel" under the PSD Program. Subgroup 3 has not reached a consensus on this issue. We interpret the recommendation to suggest that combustion of biomass would be subject to the BACT analysis, but that when evaluating the control effectiveness of biomass on carbon dioxide emissions (as compared to the combustion of fossil fuels), factors such as sourcing, sustainability practices, and significant indirect emissions could be taken into account. Treating combustion of biomass as a potentially "clean fuel" on a case-by-case basis, however, implicates the same issues as to which this subgroup has been unable to reach consensus, namely which emissions and reductions of carbon dioxide associated with the lifecycle of the fuel should be taken into account.

<u>Additional Materials used by the Subgroup:</u>

1. AF&PA paper on carbon neutrality of biomass
2. Science article referenced in footnote 12
3. Presentation to full Workgroup on December 3rd

[13] *See* Proposed RFS-2, 74 Fed. Reg. at 25024.

American Forest & Paper Association

BIOMASS CARBON NEUTRALITY

The carbon neutrality of biomass is a longstanding and widely established principle. Organizations recognizing the carbon neutrality of biomass emissions include the European Union, U.S EPA and the UN's Intergovernmental Panel on Climate Change (IPCC), as well as recent federal and state legislation promoting renewable electricity and biofuels.

The combustion of biomass is carbon neutral.
When biomass such as wood is combusted for energy, it releases back into the atmosphere carbon dioxide that it had absorbed from the atmosphere during growth[1]. When harvested biomass is replanted, the cycle repeats. In contrast, combustion of fossil fuel is not carbon neutral. The combustion of natural gas, coal and petroleum fuels results in a net increase of carbon dioxide in the atmosphere. This carbon dioxide is from natural sinks created million of years ago and, unlike when harvested biomass is replanted, there is no balancing cycle to remove it from the atmosphere. When combusted, it is properly counted as a carbon emission.[2]

The carbon neutrality of biomass combustion is a widely-accepted carbon accounting convention.
The EPA's comprehensive accounting of total US carbon emissions accounts for carbon stock changes related to land use. In its most recent 2007 report to the UN Framework Convention on Climate Change, EPA reported that carbon stocks in U.S. forests continue to increase at a rate of more than 800 million metric tons of carbon dioxide equivalents annually. Based on this accounting, the fact that forestland in the US serves as a net sink for carbon dioxide rather than a source of emissions, is reflected in current US domestic policy that recognizes emissions from the combustion of biomass as carbon neutral.

Forests carbon stocks are increasing in the U.S.
The benefits of the carbon neutrality of biomass combustion are sustained when overall biomass stock is renewed. Policymakers have indicated that this is best considered at a national level. Because biomass is the raw material for the forest products industry, its re-growth and management is essential to our industry's existence, which is why we put significant emphasis on sustainable forestry practices. There is more forestland in the U.S. today than just 20 years ago and, as a signatory to the UN Framework Convention on Climate

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[1] Other greenhouse gases are also emitted in trace amounts during combustion. This paper only refers to carbon dioxide when using the term "carbon neutrality."

[2] Recently, there has been some confusion about this principle. For example, a recent policy article in *Science* magazine, "Fixing a Critical Climate Accounting Error," Searchinger, et al., calls the carbon neutrality of biomass combustion an accounting error that can only be corrected by a detailed accounting of land use, which would allegedly show biomass combustion as not carbon neutral. The article seems to promote proper life cycle accounting to avoid the theoretical case in which the carbon neutrality at the combustion stage may be overcome by emissions in other life cycle stages. However, additional net emissions which occur and are accounted for in other life cycle stages of a fuel do not negate biomass combustion carbon neutrality at a given stage. The article also fails to recognize that this accounting is performed annually in the United States and its results support the basis for carbon neutrality of biomass in U.S. domestic policy. In addition, it does not acknowledge that while we cannot account through bookkeeping for the net impact of the land around the world on emissions, we do know that the land-to-atmosphere flux is a net sink and not a net source.

Change, the U.S. EPA has reported since 2000 that the nation's supply of wood fiber is sustainable and not diminishing. Carbon stored in forests and forest products offsets 10 percent of annual U.S. carbon dioxide emissions. Given recent policy incentives and mandates for renewable energy which recognize biomass carbon neutrality but do not incorporate incentives for additional biomass supplies to increase carbon stocks, concerns over the depletion of forest resources or conversion of forests to other land uses for the production of biomass crops other than trees is a significant concern. However, reversing the long standing principle of carbon neutrality of biomass is not the correct policy response. Instead, policy makers should focus on promoting sustainable forest management and increasing forest stocks.

Failure to recognize the carbon neutrality of biomass could lead to unintended negative consequences.

Increasing fossil fuel use and GHG emissions: Absent policies to encourage the use of biomass for energy as a result of its carbon neutrality, energy users will prefer fossil fuels as they have higher heating values, and therefore, are more efficient. This will increase carbon in the atmosphere and do nothing to stop the natural, ongoing carbon cycle of biomass which will continue with or without human intervention as trees fall, die and re-grow.

Reducing forest land: The sophisticated and accurate national accounting methods to conduct and report carbon stocks in GHG inventories are not applicable at the local level. Further, applying complicated land-use accounting conventions to domestic circumstances at the local level is unnecessary and would create dis-incentives for private forest owners—who own 70 percent of all forests in the US— who may convert their land to other uses, such as development, thereby permanently reducing U.S. forests and carbon stocks.

Creating substantial uncertainty and deterring growth of renewable energy: Removing the carbon neutrality of biomass eliminates the fundamental tenet underlying its favorable consideration as an energy source, which could scare away investors and industries just as they are poised to commit to major investments in emerging technologies.

Driving jobs away from the U.S. and toward jurisdictions that recognize biomass carbon neutrality: Eliminating biomass carbon neutrality would eliminate a potential cost mitigating compliance strategy for companies under upcoming U.S. climate change policies. The resulting increases in operation costs would likely render some facilities uncompetitive and force them to relocate outside of the U.S. to jurisdictions without carbon regulations.

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complement prior studies that highlight the importance of short- and medium-lived pollutants (*14–17*).

The top 10 pollutant-generating activities contributing to net RF (positive RF minus negative RF) in year 20 are shown in the bottom chart, page 526), which takes into account the emission of multiple pollutants from each source activity (*18*). The seven sources that appear only on the left side (purple bars) would be overlooked by mitigation strategies focusing exclusively on long-lived pollutants.

The distinctly different sources of near-term and long-term RF lend themselves to the aforementioned two-pronged mitigation approach. This decoupling is convenient for policy design and implementation; whereas the importance of long-term climate stabilization is clear, the perceived urgency of near-term mitigation will evolve with our knowledge of the climate system. Additionally, optimal near-term mitigation strategies will reflect decadal oscillations (*19*), seasonal and regional variations (*20*, *21*), and evolving knowledge of aerosol-climate effects (*22*, *23*) and methane-atmosphere interactions (*22*)—considerations unique to the near term.

Thus, short- and medium-lived sources (black carbon, tropospheric ozone, and methane) must be regulated separately and dynamically. The long-term mitigation treaty should focus exclusively on steady reduction of long-lived pollutants. A separate treaty for short- and medium-lived sources should include standards that evolve based on periodic recommendations of an independent international scientific panel. The framework of "best available control technology" (strict) and "lowest achievable emissions rate" (stricter) from the U.S. Clean Air Act (*24*) can be used as a model.

Such a two-pronged institutional framework would reflect the evolving scientific understanding of near-term climate change, the scientific certainty around long-term climate change, and the opportunity to separately adjust the pace of near-term and long-term mitigation efforts.

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Supporting Online Material

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CLIMATE CHANGE

Fixing a Critical Climate Accounting Error

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Rules for applying the Kyoto Protocol and national cap-and-trade laws contain a major, but fixable, carbon accounting flaw in assessing bioenergy.

The accounting now used for assessing compliance with carbon limits in the Kyoto Protocol and in climate legislation contains a far-reaching but fixable flaw that will severely undermine greenhouse gas reduction goals (*1*). It does not count CO_2 emitted from tailpipes and smokestacks when bioenergy is being used, but it also does not count changes in emissions from land use when biomass for energy is harvested or grown. This accounting erroneously treats all bioenergy as carbon neutral regardless of the source of the biomass, which may cause large differences in net emissions. For example, the clearing of long-established forests to burn wood or to grow energy crops is counted as a 100% reduction in energy emissions despite causing large releases of carbon.

Several recent studies estimate that this error, applied globally, would create strong incentives to clear land as carbon caps tighten. One study (*2*) estimated that a global CO_2 target of 450 ppm under this accounting would cause bioenergy crops to expand to displace virtually all the world's natural forests and savannahs by 2065, releasing up to 37 gigatons (Gt) of CO_2 per year (compa-

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rable to total human CO_2 emissions today). Another study predicts that, based solely on economic considerations, bioenergy could displace 59% of the world's natural forest cover and release an additional 9 Gt of CO_2 per year to achieve a 50% "cut" in greenhouse gases by 2050 (*3*). The reason: When bioenergy from any biomass is counted as carbon neutral, economics favor large-scale land conversion for bioenergy regardless of the actual net emissions (*4*).

The potential of bioenergy to reduce greenhouse gas emissions inherently depends on the source of the biomass and its net land-use effects. Replacing fossil fuels with bioenergy does not by itself reduce carbon emissions, because the CO_2 released by tailpipes and smokestacks is roughly the same per unit of energy regardless of the source (*1*, *5*). Emissions from producing and/or refining biofuels also typically exceed those for petroleum (*1*, *6*). Bioenergy therefore reduces greenhouse emissions only if the growth and harvesting of the biomass for energy captures carbon above and beyond what would be sequestered anyway and thereby offsets emissions from energy use. This additional carbon may result from land management changes that increase plant uptake or from the use of biomass that would otherwise decompose rapidly. Assessing such carbon gains requires the same accounting principles used to assign credits for other land-based carbon offsets.

For example, if unproductive land supports fast-growing grasses for bioenergy, or if forestry improvements increase tree growth rates, the additional carbon absorbed offsets emissions when burned for energy. Energy use of manure or crop and timber residues may also capture "additional" carbon. However, harvesting existing forests for electricity adds net carbon to the air. That remains true even if limited harvest rates leave the carbon stocks of regrowing forests unchanged, because those stocks would otherwise increase and contribute to the terrestrial carbon sink (*1*). If bioenergy crops displace forest or grassland, the carbon released from soils and vegetation, plus lost future sequestration, generates carbon debt, which counts against the carbon the crops absorb (*7*, *8*).

The Intergovernmental Panel on Climate Change (IPCC) has long realized that bioenergy's greenhouse effects vary by source of biomass and land-use effects. It also recognizes that when forests or other plants are harvested for bioenergy, the resulting carbon release must be counted either as land-use emissions or energy emissions but not both. To avoid double-counting, the IPCC assigns the CO_2 to the land-use accounts and exempts bioenergy emissions from energy accounts (*5*). Yet it warns, because "fossil fuel substitution is already 'rewarded'" by this exemption, "to avoid underreporting . . . any changes in biomass stocks on lands . . . resulting from the production of biofuels would need to be included in the accounts" (*9*).

This symmetrical approach works for the reporting under the United Nations Framework Convention on Climate Change (UNFCCC) because virtually all countries report emissions from both land and energy use. For example, if forests are cleared in Southeast Asia to produce palm biodiesel burned in Europe, Europe can exclude the tailpipe emissions as Asia reports the large net carbon release as land-use emissions.

However, exempting emissions from bioenergy use is improper for greenhouse gas regulations if land-use emissions are not included. The Kyoto Protocol caps the energy emissions of developed countries. But the protocol applies no limits to land use or any other emissions from developing countries, and special crediting rules for "forest management" allow developed countries to cancel out their own land-use emissions as well (*1*, *10*). Thus, maintaining the exemption for CO_2 emitted by bioenergy use under the protocol (*11*) wrongly treats bioenergy from all biomass sources as carbon neutral, even if the source involves clearing forests for electricity in Europe or converting them to biodiesel crops in Asia .

This accounting error has carried over into the European Union's cap-and-trade law and the climate bill passed by the U.S. House of Representatives (*1*, *12*, *13*). Both regulate emissions from energy but not land use and then erroneously exempt CO_2 emitted from bioenergy use. In theory, the accounting system would work if caps covered all land-use emissions and sinks. However, this approach is both technically and politically challenging as it is extremely hard to measure all land-use emissions or to distinguish human and natural causes of many emissions (e.g., fires).

The straightforward solution is to fix the accounting of bioenergy. That means tracing the actual flows of carbon and counting emissions from tailpipes and smokestacks whether from fossil energy or bioenergy. Instead of an assumption that all biomass offsets energy emissions, biomass should receive credit to the extent that its use results in additional carbon from enhanced plant growth or from the use of residues or biowastes. Under any crediting system, credits must reflect net changes in carbon stocks, emissions of non-CO_2 greenhouse gases, and leakage emissions resulting from changes in land-use activities to replace crops or timber diverted to bioenergy (*1*).

Separately, Europe and the United States have established legal requirements for minimum use of biofuels, which assess greenhouse gas consequences based on life-cycle analyses that reflect some land-use effects (*1*, *14*). Such assessments vary widely in comprehensiveness, but none considers biofuels free from land-based emissions. Yet the carbon cap accounting ignores land-use emissions altogether, creating its own large, perverse incentives.

Bioenergy can provide much energy and help meet greenhouse caps, but correct accounting must provide the right incentives.

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Supporting Online Material

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Subgroup 3 Recommendations

Carbon Neutrality

December 3, 2009

Recommendations

- *Consensus*: Defer determination of biomass carbon neutrality to full workgroup
- Broader policy implications than scope of subgroup – energy, environment, and tradeoffs
- Differing opinions – cover briefly
  - Yes, support biomass carbon neutrality
  - Case by case life cycle assessment of biomass fuels to show carbon neutrality

What is Biomass Carbon Neutrality?

- Differentiates between biomass-derived carbon from fossil-fuel derived carbon – highlights role in the global carbon cycle.
- Part of a relatively rapid natural cycle that neither adds nor subtracts carbon to/from the atmosphere when in balance
- The carbon dioxide (CO_2) removed from the atmosphere during photosynthesis is converted into organic carbon and stored in biomass, such as trees and crops.
- When harvested and combusted, the carbon in the biomass is released as CO_2, thus completing the carbon cycle

Internationally Accepted Accounting Convention

- International accounting conventions recognize the difference between fossil fuel emissions and carbon flows related to the natural carbon cycle.

- The Intergovernmental Panel on Climate Change (IPCC) counts the combustion of fossil-based fuel as GHG emissions while accounting for emissions and sequestration related to land use separately.

- Biomass- related carbon flows only affect atmospheric carbon if there is an imbalance between the rate of uptake of CO_2 by plants and the rate of return of biogenic carbon to the atmosphere (through combustion, decay or respiration).

Recognition of Biomass CO2 Neutrality

- EPA Mandatory Reporting of GHGs Rule
  - excludes biomass CO_2 emissions quantities for the calculation of thresholds for determining regulated facilities.
- European Union Emissions Trading Scheme (EU ETS)
  - excludes emissions from biomass
- House passed American Clean Energy and Security Act of 2009 (EISA, Waxman-Markey) & Senate Clean Energy Jobs and Power Act - both exclude emissions from biomass
- Numerous other GHG Reporting Protocols – DOE, etc.

Concern with Carbon Neutrality

- As incentives for the use of renewable fuels increases, concern arises over the potential depletion of forest carbon stocks due to the overuse or unsustainable use of the forest resource
  - potential upset of the carbon balance

Land Use Carbon Balance – U.S.

- EPA inventories have consistently demonstrated that in the U.S. land use is a net sink for GHGs.

- U.S. forest carbon continues to grow at a rate of over 800 million metric tons of CO_2 equivalents per year (Inventory of U.S. Greenhouse Gas Emissions and Sinks, 2007).
  - This is equivalent to approximately 10% of annual GHG emissions in the U.S.
  - This annual net gain in forest ecosystem carbon stocks shown in the EPA inventory includes losses due to land use change.
  - Even on the U.S. timberland supplying wood to the forest products industry, carbon stocks are stable or increasing (NCASI Special Report 08-05, 2008).

- The forest carbon cycle in the U.S. is in balance and achieving net removals of CO_2 from the atmosphere - now and in foreseeable future (next decade)
- Global carbon stocks are also in balance

Appropriate Policy Response

- National Accounting is appropriate
  - Imbalances in the biomass carbon cycle are relevant only over large areas
  - U.S. Forest Service tracks inventories
  - Land use measurements that would require stand-by-stand or case by case accounting are not relevant to atmospheric concentrations of CO_2.
- Emissions related to net deforestation should be addressed at a national level

Appropriate Policy Response

- Increased demand for the forest resource due to renewable energy mandates and incentives can be addressed through:
  - Sustainable forest management
  - Policies to increase biomass supply, and
  - Periodic monitoring of carbon stocks on a national scale as USFS does

Adverse Policy Outcomes

- If carbon neutrality of biomass is <u>not</u> upheld on a national basis:
  - Preference for coal over biomass due to BTU differentials
  - Deter investment in renewable energy markets
  - Runs counter to Administration's renewable energy policies and mandates.
  - Create uneven playing field across jurisdictions
  - Kill biomass based efficiency projects given PSD/BACT process burdens and delays
  - Life cycle assessments required for other fuels that have indirect emissions bogging down PSD further

Carbon neutrality versus lifecycle assessments

- Lifecycle studies assess the overall environmental or carbon benefits of its use incuse including direct effects of land use changes.
- Carbon neutrality of biomass is simply one input into the total life cycle emissions calculation of biomass fuel production
- These studies aggregate GHG emissions, both direct and indirect, for each biofuel and then compare them to the statutory (EISA}-required thresholds for the different biofuels.
- These thresholds are simply the required GHG reduction compared to a fossil-fuel based transportation fuel baseline that each category of biofuel must achieve.
- These are not determinations on the carbon dioxide neutrality of biomass. Explicit in the EPA assessment is the recognition that CO_2 emissions from the combustion of these transportation biofuels are neutral or zero.

Alternative Recommendation #1

- Biogenic CO2 emissions should be excluded from major source and project significance threshold determinations
- Biogenic emissions are carbon neutral for netting as well
- If project has mix of fossil and biomass fuels, counting fossil could still trigger BACT

Alternative Recommendation #2

- Carbon neutrality is not a given – biomass fuel's lifecycle must be examined
- Identify factors that increase atmospheric CO2 concentrations (white paper)
  - Type of fuel – wastes, plant residuals, etc
  - Source of biomass – existing, managed, newly cleared/cultivated, old growth
  - Direct emissions from processing and transportation of fuel
  - Indirect emission of plant and soil carbon from global land conversion
- States consider factors on case by case basis

Alterative #2 – cont.

- Case by case determination of neutrality by States based on white paper factors
- White paper could identify situations where biomass combustion is offset by growth
  - Forest residues from existing plantations
  - Crop residues from existing ag land

Rationale

- Must account for direct and indirect emissions of biomass production – lifecycle assessment of land use changes
- EISA requires lifecycle assessment for biofuels
- UN recognizes various bioenergy types reduce GHG differentially
- EU concerned that land use changes could negate savings from biofuels
- Any accounting procedure must consider source of biomass and net land use effects

Scope of Accounting

- Use of biomass energy in US affects global land use patterns
- EPA's RFS II recognizes that domestic biofuels can change international land uses
- Carbon balancing must be done at global scale

Wrap Up

- Pass the issue to the full Workgroup